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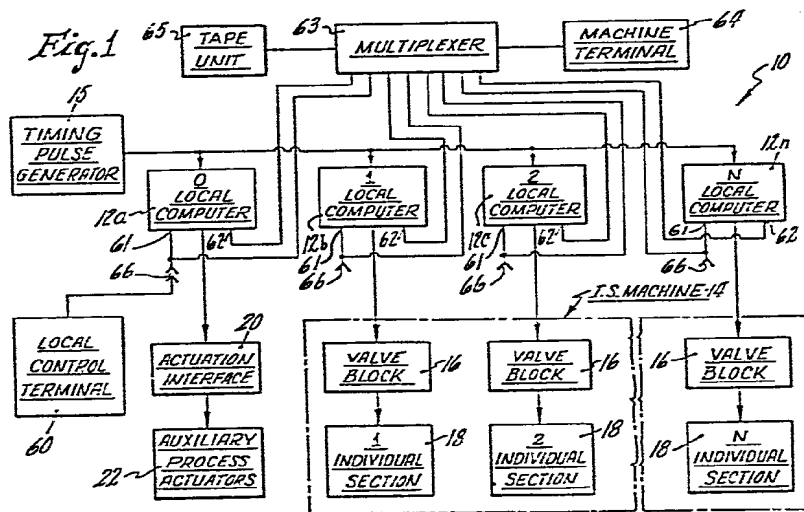
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(54) Programmable control system for glassware forming machines.

(57) A control system for the control of a multi-section glassware forming machine in a manner which enables totally independent operation of any section regardless of the status of remaining sections. The control program for each section is stored in unalterable, read-only memory within a local computer associated respectively with each section. Each local computer is provided with at least two communication ports. A local terminal may be selectively connected to any local computer via one of the communication ports to enter and display timing setting data. A machine terminal or machine supervisory computer may be selectively connected to any local computer through the other one of the ports. A bidirectional communications interface enables data transfer between the selected local computers and selected data input/output devices.

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PROGRAMMABLE CONTROL SYSTEM FOR  
GLASSWARE FORMING MACHINES

Background of the Invention

Field of the Invention

The invention relates generally to controllers for controlling the cyclical operation of a plurality of machine components. More specifically, the invention relates to computer based timing and control of the plurality of components in each section of a multi-section glassware forming machine.

Description of the Prior Art

Electronic timing or control systems are well known for the control of a plurality of components of a machine. In some machines the components are arranged in a plurality of identical sections, each operating independently of the others in predetermined phase relationship relative to the machine cycle. Prior art electronic control systems have controlled the operation of such sections as a unit and have consequently required use of a single central processing unit (CPU) or supervisory controller connected in hierarchical fashion to a plurality of section controllers. A disadvantage of such systems is that a malfunction of the central controller of the hierarchy prevents operation of any subordinate section controllers.

An example of a multi-section machine of this type is the well-known individual section (IS) glassware forming machine. Electronic timing systems for glassware-forming machines have been used for many years in place of mechanical, rotating timing drums. The old timing drums control the

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actuation of the various components within each section of the machine by actuating associated pneumatic valves with cams placed in circumferential grooves on the drum surface. Electronic timing systems replaced the rotating drum and cams with a solenoid actuated valve block (such as that disclosed in U.S. Patent No. 3,918,489 assigned to the assignee of the present invention) and control means for actuating selected valves at predetermined times in a predetermined sequence relative to a machine cycle reference point. One major advantage of electronic timing systems is the ease with which the timing settings of the various components may be adjusted during machine operation.

Some prior art IS machine electronic timing systems use timing pulse generators and counters to count pulses occurring during the machine cycle and compare the current count to preset counts to determine when each component or machine event should be actuated (for example, U.S. Patent No. 3,762,907). Other prior art electronic timing systems use similar count comparisons, but store the preset component timing settings (or machine events) in a core memory (for example, U.S. Patent No. 3,974,432). Each device disclosed in these two prior art patents serves to control actuation of all section components within the machine but does not provide for independent control of each section.

Programmable automatic machine controllers are also known in the prior art as shown in U.S. Re. No. 29,642. This controller, however, utilizes a central machine console to couple data to and from

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each individual section memory unit, thus also preventing totally independent section operation. A similar centrally oriented system, but one incorporating feedback sensors and means for varying the duration of all events in response thereto, is shown in U.S. Patent No. 4,108,623.

Another type of programmable prior art controller is disclosed in U.S. Patent No. 4,152,134. This device is limited because it requires a central, machine supervisory computer to load control program and timing data into individual section computers. A malfunction in the machine supervisory computer would affect efficient operation of the sections of the machine.

Yet another programmable controller is disclosed in U.S. Patent No. 4,247,317 which shows one way to store event timing data in a random access memory and means to alter same. This device uses a central console to control the relative timing of each section which effectively ties all section computer-memory controllers together into one hierarchical machine control system incapable of truly independent section operation.

U.K. Patent Specification No. 1,594,532, assigned to the assignee of the present invention, discloses a prior art electronic control system which utilizes independent, asynchronous clock signals which are produced at a rate independent of the speed of the glassware forming machine. The system disclosed is also for the control of a machine rather than a section.

Other examples of electronic controllers using

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one computer to control all sections of a machine are disclosed in U.S. Patent No. 3,877,915 and Re. No. 29,188, assigned to the assignee of the present invention.

5 U.K. Patent GB 2,022,870B discloses a control system with one memory controller controlling each section of a machine. Even if this memory controller is implemented by a microcomputer (as is disclosed in the patent) the microcomputer merely  
10 emulates the memory controller's function and the necessary result is a simplistic cycling of the memory controller through a predetermined sequence of steps. There is no means disclosed for enabling modification of this predetermined sequence of steps  
15 at the section level in response to operator control. While the operator may adjust timing, there is no disclosure of means by which the operator could change the actual sequence of steps at the section level. Furthermore, the U.K. patent  
20 discloses a device necessitating a hierarchical computer or some other external type of loading mechanism for loading a control program. This is a limitation of the independence of the machine sections because they are dependent on an external  
25 loading device. Furthermore, this U.K. patent does not disclose means for controlling auxiliary machine functions.

All of the above prior art patents generally disclose a control system architecture comprising a  
30 "machine" controller and a plurality of subordinate "section" controllers. Such prior art devices therefore have the disadvantage of either requiring

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external devices to load control program data or of causing a shut down or inefficient operation of the entire machine in the event the main supervisory computer goes down.

5           Accordingly, there is a need for an individual section, independent programmable controller capable of independent control of each section of a machine. Such an independent structure would enable simultaneous operation of some or all sections of a  
10 machine and permit repairs of selected section controllers without affecting the operation of other sections or necessitating shutting down the entire machine.

          The operation of prior art IS machines  
15 generally necessitates the operation of several desirable auxiliary or machine functions which are common to all sections although not required for the operation of any one section. Auxiliary function controls include, for example, controls for drive  
20 systems (controlling feeders, shears, gob distributors, conveyors, ware transfer devices, etc.), alarms (to signal warnings or malfunctions), shear spray (to lubricate and cool gob shears), cullet water and equipment, stackers (forlehr  
25 loading), surface coating equipment, etc. The operation of these auxiliary functions is somewhat related to the operation of the sections of the machine although each section can operate independently of the auxiliary functions.

30           Aforementioned U.S. Patent No. 4,152,134 discloses the auxiliary function of selective bottle rejection. However, the machine supervisory

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computer disclosed in that patent provides the necessary link between each individual section and the bottle reject device. A malfunction of the machine supervisory computer would sever this link  
5 for all sections, thus preventing operation of this or other auxiliary functions with any section. Additionally, similar disadvantages arise when peripheral data input/output devices (such as  
10 keyboards, tape storage units or alphanumeric displays) are interfaced with the several sections through a hierarchical control structure.

Accordingly, it is another object of this invention to provide a control system to enable individual section independent control while also  
15 enabling isolated data communication between selected independent section controllers and selected peripheral data input/output units including auxiliary function devices.

#### SUMMARY OF THE INVENTION

20 These and other objects of the invention are achieved by the preferred embodiment disclosed herein which comprises a computer controlled timing system for controlling the actuation of a plurality of components of each section of a machine in  
25 accordance with a predetermined control program and selected timing data, said machine including a plurality of said sections each independently operable in phased relationship within the cycle of operation of said machine, said system for enabling  
30 the simultaneous and independent operation of said plurality of sections, said system comprising:

a plurality of local computer means, each



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respectively associated with one of said sections, each of said local computer means having non-volatile storage means containing said predetermined control program and for  
5 containing said selected timing data therein for controlling the operation of its respective section independently of any other one of said sections;

10 a plurality of interface means each interposed respectively between one of said local computer means and its associated section for actuating the components of said section in accordance with said predetermined control program and said selected timing data;

15 terminal means for the display of predetermined portions of said predetermined control program, for the display and entry of said selected timing data and for the display and entry of other timing data to replace  
20 chosen portions of said selected timing data;

bidirectional communications means for selectively connecting said terminal means to a selected one of said local computer means.

25 In one embodiment disclosed herein the control system further comprises:

a) a plurality of local computer means, each respectively associated with one of said sections, each of said local computer means comprising:

30 an unalterable program storage means for storing said predetermined control program;

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a non-volatile setting storage means  
for storing said selected timing data;  
first and second independent commun-  
ication ports for enabling interactive data  
communication between said local computer  
means and means connected to either of said  
ports;

b) a global terminal means operatively  
connected to a machine supervisory computer  
means;

c) a machine supervisory computer means  
operatively connected to said first  
communication ports and said global terminal  
means for selectively connecting said global  
terminal means to a selected one of said first  
communication ports, said machine supervisory  
computer not inhibiting the independent  
operation of said plurality of sections;  
d) a plurality of interface means each  
interposed respectively between each of said  
local computer means and its associated section  
for actuating the components of said section in  
accordance with said predetermined control  
program and said selected timing data.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic block diagram of one  
embodiment of the invention installed for control of  
a multi-section glassware forming machine;

Figure 2 shows a more detailed schematic block  
diagram of a portion of Figure 1;

Figure 3 is a diagrammatic view of the local  
terminal shown in Figure 1;

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Figure 4 is diagrammatic view of the machine terminal shown in Figure 1;

Figure 5 is a more detailed schematic of the multiplexer shown in Figure 1;

5        Figure 6 shows a schematic block diagram of an embodiment of the invention utilizing a global control terminal;

Figure 7 is a diagrammatic representation of three operator control panels.

10        DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to Figure 1 there is shown a control system 10 comprising a plurality of independent, individual stand alone section controllers (SASCON) or local computers 12b-12n each  
15        one of which includes identical hardware components although being capable of containing unique software. Each local computer 12 is assigned to a different section of an n-section multi-section machine, for example, a glassware I.S. forming  
20        machine 14. Timing pulse generator 15 provides synchronizing pulses to each local computer 12. The phased operation of each section is determined by the program within each local computer which basically offsets its respective starting point a  
25        predetermined amount from a synchronizing pulse. As shown in Figure 1, a stand alone machine controller (SAMCON) or local computer "0" may be used to control auxiliary machine processes. In the case of a glassware forming machine these processes could  
30        be, for example, shear spray, cullet water and equipment, stacker, surface coating, alarms, drive systems for a feeder, shears, gob distributor

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conveyor, ware transfer devices etc. Local computer "0" is identical to all other local computers 12 from a hardware point of view and is therefore designated by the numeral 12a.

5       The output of each local computer 12 is connected to a valve block 16 which serves as the actuation interface for actuating the various valves associated with the plurality of mechanical components in each corresponding individual section  
10 18. The output of local computer 12a for controlling all auxiliary machines processes is connected by an actuation interface 20 to various auxiliary process actuators 22. As stated before, a single local computer 12a may be used to control a  
15 plurality of auxiliary process actuators 22. For example, one actuator could be associated with a ware transfer device, another could be associated with a gob distributor, etc.

Each local computer 12 is further provided with  
20 two data communications ports: terminal port 61 and tape port 62. Each port 61 and 62 of each local computer 12 is connected to multiplexer 63 which is in turn connected to machine terminal 64 and tape unit 65. Plug 66 on each local computer 12 is a  
25 port to which a local or hand-held terminal 60 may be selectively connected. As will be discussed below, selected control data or timing setting data from any chosen local computer may be entered or displayed either at machine terminal 64 or hand-held  
30 terminal 60. If desired, several operators could control several sections simultaneously by each operator using his own hand-held terminal 60.

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As shown in Fig. 2, each local computer 12 includes a fixed, unalterable read only memory 50 and a non-volatile random access memory 52. In the preferred embodiment, ROM 50 comprises preprogrammed ROM chips (PROMs) for storing a predetermined control program to control the operation of each individual local computer 12 in accordance with timing settings or data which may be entered into RAM 52. Each local computer 12 may have different control programs stored in its ROM 50 depending on the function to be performed. For example, the control program stored in the local computer 12a associated with the auxiliary functions may be different from that stored in the local computers 12b-12n. The timing data in RAM 52 may be preprogrammed or may be entered by a machine operator through hand-held local terminal 60 or machine terminal 64. RAM 52 is non-volatile and may be connected to a battery back-up pack (not shown) to assure that the data in RAM 52 is not lost in the event of inadvertent power failure.

Each local computer 12 also includes a central processing unit 54 and data communications interfaces 56 and 58 interconnecting CPU 54 to local ports 61 and 62, respectively. While ports 61 and 62 are is shown in Figure 1 as being connected to multiplexer 63 this is not necessary for the operation of the preferred embodiment. Since one advantage of the invention is its flexibility and interchangeability of components, all local computers 12 are identical from a hardware point of view and are, in practice, constructed with both

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ports 61 and 62. However, only port 61 and plug 66 need be used since data input and output can be accomplished through hand-held terminal 60. The machine terminal 64 is nevertheless used in the preferred embodiment to provide the operator with a convenient, centrally located access point for all sections. Each local computer 12 also includes a non-volatile random access memory 69 for storing machine data representative of the particular machine with which the respective section of the local computer 12 is associated. Machine data may be considered superimposed on timing setting data and depends on the particular installation and user and may be, for example, data specific to the operation of a particular machine such as the number of sections, number of gobs or other peculiarities of machine operations. Machine data also includes set-up data such as assigning particular actuator valves to specific computer output drivers. The invention thus permits the flexibility to assign different drivers to different valves in the event any driven output becomes defective. Local control panels 67 and 68 are mounted on each individual section 18, one on the blank side of the machine and one on the blow side. Each control panel provides local operator control of various functions as is explained below with reference to Figure 8.

In one preferred embodiment each local computer 12 was chosen to be a Z-80 microcomputer with a 20K ROM, a 2K non-volatile timing data and media storage and a 1K RAM.

An example of a portable, hand-held local

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computer terminal 60 is shown in Figure 3. The basic structure of such a local terminal is a conventional unit available from many sources although the invention includes the unique functions to which the various keys are assigned. The particular local terminal 60 shown in Figure 3 includes keypad 70 having three groups of keys: the timing group comprising functions keys 71 - 75; the data entry group comprising the digits and keys 76 and 77; and the menu group comprising keys 78 - 80. Terminal 60 also includes LED display 81 (two rows, sixteen characters each).

A sample display on local terminal 60 is shown in Figure 3 to include character groups 82 - 86. Group 82 represents the number of the event chosen by the operator for display. Group 83 comprises either an "X" or an "O" to indicate whether the "off" timing setting or the "on" timing setting, respectively, will be changed by the entry of data. The operator may alternately select either one of these characters by using key 72. Group 84 represents the name of the event (either in full or abbreviated form). This name appears automatically as a function of the number of the event identified by group 82. Group 85 represents the "on" time in degrees at which the particular event is actuated. Similarly, group 86 represents the "off" time at which that event is deactivated. The "on" and "off" times are automatically displayed to represent the then current values associated with the particular chosen event. Depending upon the character represented in group 83, keys 73 and 74 will either

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incrementally increase or decrease the "on" or "off" times accordingly. If a totally new timing setting is desired such that incremental changes would be too time consuming, key 75 may be depressed to  
5 enable the entry of a new timing value by depressing the selected digits and enter key 77.

The control program for controlling is menu driven and is accessible to the operator by use of the menu group of keys 78 -80. Access to the  
10 control program is made at predetermined points in the program to enable operator entry of various instructions, machine setting data or timing setting data. The key arrangement on terminal 60 is advantageous because it permits the functionality of  
15 the control system to be independent of the hardware. That is, the software control program may be changed while still enabling use of the same hardware. The menu driven software of the control program is traversed using the menu group of keys.  
20 Once a particular request drawing instruction is presented on display 81, the "do" key 78 will enable the operator to access the corresponding submenu, if any, by executing the menu item in the display. This procedure continues until the software gets to  
25 a terminal node at which the particular menu item displayed will be performed (e.g. timing setting data will be entered). The next and previous keys 79 and 80 enable quick access to menu items. The next key 78 causes the display to cycle through the  
30 predetermined menu list in order to prompt the operator to access menu items in a predetermined order to enhance system control.



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Terminals 60 or 64 may be used to enter or display timing setting data or machine data in memories 52 and 66, respectively. For example, the various events utilized in sequence to form an article of glassware (as described in U.S. Patent No. 3,877,915) and their corresponding timing settings may be entered, changed and displayed by activation of the various function keys in keypad 70.

A more detailed diagrammatic view of machine terminal 64 having a keyboard 105 and display 106 is shown in Figure 4. The keyboard and display of machine terminal 64 provide the same input/output capability as hand-held terminal 60 and further provide additional capabilities to enable the machine operator to input or output data for a selected section from a central location while not interfering with the totally independent operation of each machine section. Keyboard 105 includes a portion 107 functionally similar to keypad 70 of hand-held terminal 60 and a portion 108 unique to machine terminal 64. Portion 108 includes function keys 109 and 110 for selecting "section up" or "section down," respectively in order to enable the operator to choose a section number and increment or decrement that number to get data access to another section. "Event fill" key 111 enables timing data from any selected local computer 12 to be temporarily stored in a temporary data storage (not shown) and to be loaded therefrom into another selected local computer 12, thus facilitating duplication of timing setting data in the several

local computers 12 without the necessity of entering data into each one separately. In the prior art systems developed and sold by the assignee of this invention a similar function was performed by  
5 transferring data from one portion of a single memory to another portion of the same memory. The fill function may also be accomplished in the embodiment shown in Figure 1 by the addition of a microcomputer (not shown) between all local  
10 computers 12 and multiplexor 63. Keys 112 and 113 may be assigned other desired functions which are not enumerated herein.

Display 106 is, in one embodiment, a one line, twenty character display. A representative display  
15 is shown in Figure 4 as being identical to the display shown on the hand-held terminal in Figure 3 with an additional character group 114 showing the number of the section to which the remaining characters pertain at any one time.

20 Referring now to Figure 5 there is shown a more detailed schematic of the multiplexer 63 in the preferred embodiment shown in Figure 1. Data entered from keyboard 105 provides binary parallel inputs to decoder 102 (actually part of 64). In response to a  
25 unique binary input, decoder 102 activates a selected one of its outputs  $S_0$  to  $S_N$ , each of which is connected respectively to the enabling terminal of a bidirectional communications gate 120. Gate 120 may be, for example, an RS422 dual input chip with tri-  
30 state enable. The input terminals A and B of each gate 120 are connected respectively to the output of RS422 bidirectional gates 122 and 124. The enabling

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terminals of each of these gates 122 and 124 are connected so as to be continuously activated to enable data transfer between gates 122 and 124 and selected gates 120 whenever the associated enabling  
5 signal  $S_0$  to  $S_N$  is activated. In the preferred embodiment shown, gate 122 provides an interface to machine terminal 64 and gate 124 provides an interface to external archive tape storage unit 65.

In operation, only one output of decoder 102  
10 will be activated at any one time in order to enable data transfer between a particular selected section (represented by the unique input code to the decoder) and the input/output device connected to the data terminals of the gate 120 associated with  
15 that section. For example, if the  $S_1$  output of decoder 102 is activated local computer 12b for section 1 will have its communication ports 61 and 62 connected to terminal 64 and tape unit 65. This will enable local computer 12b to accept data from  
20 keyboard 105 or tape (as may be required by the control program) and will enable data from the selected local computer to be displayed on display 106. If the preprogrammed control program within the selected local computer 12b requires data  
25 transfer between it and tape unit 65 then appropriate data transfer will occur.

Referring now to Figure 6 there is shown an embodiment of the invention utilizing a machine supervisory computer 90 connected to communication  
30 port 62 of each local computer 12. Computer 90 facilitates operation of the glassware forming machine while still enabling totally independent

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operation of all individual sections and their respective local computers. Computer 90 includes a bidirectional communications interface (not shown) for interconnecting selected ones of the local  
5 computers 12 to selected input/output units connected to computer 90 such as global terminal 91, tape unit 92 and printer 93. Other peripheral I/O units may obviously be used.

Global terminal 91 includes cathode ray tube  
10 display 96 and keyboard 97. It will be noted that the global terminal keyboard is similar to the machine terminal keyboard shown in Figure 4. Indeed, global terminal 91 is similar in function to machine terminal 64, the primary difference being  
15 the inclusion of CRT display 96 in the former. Display 96 obviously enables the presentation of more data to the operator so that he may, for example, compare the timing settings of all sections simultaneously.

20 In the preferred embodiment the local and machine supervisory computers may be housed in forming control enclosure 210. Enclosure 210 may be, for example, an environment-proof enclosure complying with NEMA 12 requirements and may be  
25 situated at a convenient distance from the IS machine 14. Each local computer is identical from a hardware point of view and is a modular unit rack mounted within enclosure 210 for easy replacement if necessary. Each valve block 16 is provided with a  
30 control panel 224 and each individual section 18 is provided with a blank side control panel 67 and a blow side control panel 68. The blank and blow

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panels provide local plugs (not shown) by which hand-held terminal 60 may be connected to any selected section, from either the blank or blow side of the machine, and its associated local computer. The  
5 panels also provide the machine operator with local access to control functions such as start, emergency stop, ware reject, etc.

Machine supervisory computer 90 provides the means to interface selected ones of local computers  
10 12 to I/O devices such as tape unit 92 or printer 93. Tape unit 92 may be used to store control program data to be loaded into computer 90 to control its operation. Note that the control program stored in tape unit 92 is not the same as  
15 control program data stored in the individual local computers 12. The latter control programs are always stored in ROM within each local computer. The control program stored in tape unit 92 is used only to control the operation of computer 90 and  
20 does not inhibit in any way the independent operation of each local computer and its corresponding section.

It will be noted that machine supervisory computer 90 may provide access to all timing setting  
25 data within system 10. Hard copy printouts of any selected data may be obtained through printer 93. Computer 90 may also be provided with an output data channel 100 for providing selected data to external data processing equipment (not shown). Global  
30 terminal 91, tape storage unit 92, printer 93 or other peripheral units (not shown) may be connected to computer 90 and situated in a convenient location

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either adjacent machine 14 or in a remote control room.

In one embodiment machine supervisory computer 90 may be, for example, an LSI-11 minicomputer available from Digital Equipment Corporation. The particular LSI-11 used in this embodiment has a 256K RAM for temporary data storage to facilitate data transfer between selected local computers and peripheral units connected to computer 90. By reference to Figures 2 and 6 it will be noted that data communications between computer 90 and selected local computer 12 may occur through port 62 and associated communication interface 58. It is thus apparent that communications may occur directly between CPU 54 of the selected local computer and the central processing unit included in the LSI-11. As shown in Figure 6 hand-held terminal 60 may be connected to port 61 of a chosen local computer to provide parallel communications if desired. In any event, since each local computer 12 is provided with its own unalterable program storage means 50 as well as non-volatile timing and machine data storage means 62 and 66, respectively, each local computer 12 may operate independently of any other and independently of computer 90. Contrary to prior art control systems for glassware forming machines, no loading of control program data into local computers 12 is necessary to permit their operation.

Terminal 91 may include coded access key slots 250-253. Each key slot will accept only a predetermined key or code. The control program for

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computer 90 is written so that control and display of various data is limited to authorized personnel according to a chosen hierarchy in the glass plant. A four level access hierarchy arranging from lowest to highest may be, for example, operator, set-up crew, product management and equipment maintenance.

Operation of system 10 and access to various timing and control data within the system is a function of the particular key slot which may be activated. For example, a machine operator may operate the machine and all of its sections by inserting the proper key into slot 250 corresponding to the lowest access level (level 1). The operator may thus control display and entry of only the timing and control data necessary to perform his work and may make certain limited changes to timing setting data and the like. The operator would be prevented from accessing or making changes to other data. A set-up crew may be given a key for slot 251 and thus permitted display and entry access to all of the data available to the operator plus some additional selected data such as machine data necessary to set-up the system for operation on a particular machine (i.e. access level 2). Additional data access is similarly available by providing keys to slots 252 (level 3) and 254 (level 4) to those individuals needing access to such levels. Such a system prevents, for example, an operator from changing data beyond the scope necessary to perform his work or from obtaining access to sensitive production data.

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Referring now to Figure 7 the operator controls available on each valve block 224, overhead or blank side panel 67 and blow side panel 68 are shown in more detail. Each section is provided with the same  
5 operator controls for performing the functions of basic section control, adjustment cycle selection and operator aids.

The basic section controls available to the operator are section start (available only on panel  
10 67), normal stop to a preprogrammed position (available on panels 224 and 68), alternate stop to another preprogrammed position (available on panel 67), delivery start and stop (available on panels 224 and 68 respectively) and maintenance or  
15 emergency stop (available on panels 224 and 228).

There are adjustment cycles also available to enable the operator to cause the control system to perform a predetermined sequence of steps in order to accomplish certain features. For example, blow  
20 side panel 68 is provided with a "neckring change" control in order to position the section for easy alignment and changing of neckrings, "blowhead adjust" control for adjusting the blowhead. Blank side panel 67 is provided with a "finish  
25 measurement" control for determining the height of the bottle's finish above the mold.

Various operator aid controls are also available in order to assist the operator in performing various duties which heretofore had to be  
30 manually performed. For example, blank side panel 67 is provided with a swab control to initiate a swab cycle to automatically position the particular



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section's blank side for efficient swabbing. Similarly, panels 67 and 68 are provided with "cold blank" and "cold mold" controls for altering the sections cycle for efficient heating of blank and blow molds respectively during start up or after mold change. Ware reject controls are provided to assist the operator in automatically rejecting selected glassware. These controls are available from either the blank side or the blow side in order for the operator to be able to reject ware produced by either side. Four reject buttons are provided on each panel 67 and 68, one each for each mold within each section. (Note that the panels shown here are designed for a "quad-gob" system having four molds in each section of the machine.) Blank side panel 67 is provided with ware reject buttons enabling the rejection of bottles currently produced in the respective blank side molds such as, for example, during start up of the section. Blow side panel 68 is provided with ware reject buttons capable of either continuous rejection of bottles produced by selected blow molds or rejection of a predetermined number of bottles such as, for example, after swabbing. The control system may also be programmed to automatically select the ware reject function after activation of either "cold blanks", "cold molds", or "swab" controls.

It will understood by those skilled in the art that numerous modifications and improvements may be made on the preferred embodiments of the invention disclosed herein without departing from the spirit and scope thereof.

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WHAT IS CLAIMED IS

1. A control system for controlling the actuation of a plurality of components of each section of a machine in accordance with a predetermined control  
5 program and selected timing data, said machine including a plurality of said sections each independently operable in phased relationship within the cycle of operation of said machine, said system for enabling the simultaneous and independent  
10 operation of said plurality of sections, said system comprising:

a plurality of local computer means, each respectively associated with one of said sections, each of said local computer means  
15 having non-volatile storage means containing said predetermined control program and for containing said selected timing data therein for controlling the operation of its respective section independently of any other one of  
20 said sections;

a plurality of interface means, each interposed respectively between one of said local computer means and its associated section for actuating the components of said  
25 section in accordance with said predetermined control program and said selected timing data;

terminal means for the display of predetermined portions of said predetermined control program, for the display and entry of said  
30 selected timing data and for the display and entry of other timing data to replace chosen portions of said selected timing data;

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bidirectional communications means for selectively connecting said terminal means to a selected one of said local computer means.

2. A control system in accordance with Claim 1  
5 further comprising:

storage means for storing predetermined timing data; and

means operatively connecting said timing data storage means to said bidirectional  
10 communication means for enabling timing data transfer therebetween.

3. A control system in accordance with Claim 1 wherein said non-volatile storage means for storing said predetermined control program is an unalterable  
15 storage means.

4. A control system in accordance with Claim 1 wherein said terminal means further comprises:

display means for presenting to an operator pursuant to said predetermined control program at least one of a plurality of  
20 predetermined programmed requests for instruction or data input for prompting said operator to input an appropriate instruction or data at a predetermined point in said  
25 predetermined control program;

keyboard means for entering into said local computer means instructions or data in response to said requests.

5. A control system in accordance with Claim 4  
30 wherein said keyboard means comprises:

a group of various data keys for entering numerical data;

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a group of various timing keys for entering predetermined changes to the timing data displayed on said display means;

5 a group of various menu keys for enabling the operator to access selected portions of said control program.

6. A control system for controlling the actuation of a plurality of components of each section of a machine in accordance with a predetermined control  
10 program and selected timing data, said machine including a plurality of said sections each independently operable in phased relationship within the cycle of operation of said machine, said system for enabling the simultaneous and independent  
15 operation of said plurality of sections, said system comprising:

a) a plurality of local computer means, each respectively associated with one of said sections, each of said local computer means  
20 comprising:

an unalterable program storage means for storing said predetermined control program;

25 a non-volatile setting storage means for storing said selected timing data;

first and second independent communication ports for enabling interactive data communication between said local computer means and means connected to either of said  
30 ports;

b) a global terminal means operatively connected to a machine supervisory computer

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means;

c) a machine supervisory computer means operatively connected to said first communication ports and said global terminal means for selectively connecting said global terminal means to a selected one of said first communication ports, said machine supervisory computer not inhibiting the independent operation of said plurality of sections;

d) a plurality of interface means each interposed respectively between each of said local computer means and its associated section for actuating the components of said section in accordance with said predetermined control program and said selected timing data.

7. A control system in accordance with Claim 6 further comprising:

at least one local terminal means for being operatively connected to a selected one of said second communication ports.

8. A control system in accordance with claim 6 further comprising:

first storage means for storing first predetermined control data for controlling the operation of said machine supervisory computer; means for loading said first predetermined control data into said machine supervisory computer.

9. A control system in accordance with Claims 1 or 6 further comprising means for transferring selected timing setting data from one of said local computer means to another of said local computer means.

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10. A control system in accordance with Claims 1 or 6 wherein said local computer means further comprises:

5           a non-volatile machine data storage  
          means for storing data representative of said machine.

11. A control system in accordance with Claim 10 further comprising:

10           means for transferring machine data from  
          one of said local computer means to another of said local computer means.

12. A control system in accordance with Claims 1 or 6 further comprising:

15           access code means for enabling access  
          to selected data only upon entry of a predetermined identifying code, each identifying code being associated with predetermined portions of said selected data.

13. A control system in accordance with Claim 12  
20 wherein said access code means includes progressively increasingly restrictive levels of access to said selected data.

14. A control system for controlling the actuation of a plurality of components of each section of a  
25 machine in accordance with a predetermined control program and selected timing data, said machine including a plurality of said sections each independently operable in phased relationship within the cycle of operation of said machine, said system  
30 for enabling the simultaneous and independent operation of said plurality of sections, said system comprising:

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a) a plurality of local computer means, each respectively associated with one of said sections, each of said local computer means comprising:

5           an unalterable program storage means for storing said predetermined control program;

          a non-volatile setting storage means for storing said selected timing data;

10           first and second independent communication ports for enabling interactive data communication between said local computer means and means connected to either of said ports;

15           b) a machine terminal means having a keyboard and a line display;

          c) a tape storage unit for storing selected timing data;

20           d) a multiplexer switch means operatively connected to said machine terminal means, said tape storage unit and said first and second communication ports for selectively connecting selected ones of said ports to said machine terminal means and said tape storage unit;

25           e) a plurality of interface means each interposed respectively between each of said local computer means and its associated section for actuating the components of said section in accordance with said predetermined control  
30           program and said selected timing data.

15. A control system in accordance with Claim 14 further comprising:

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at least one local terminal means for being operatively connected to a selected one of said first communication ports.

- 5 16. A control system for controlling the actuation of a plurality of components of each section of a machine in accordance with a predetermined control program and selected timing data, said machine including a plurality of said sections each independently operable in phased relationship within  
10 the cycle of operation of said machine, said system for enabling the simultaneous and independent operation of said plurality of sections, said system comprising:
- 15 a) a plurality of local computer means each respectively associated with one of said sections, each local computer means having at least one bidirectional data port;
  - b) at least one output receiving means for receiving data from said data ports;
  - 20 c) input producing means for entering data into said data ports;
  - d) a plurality of bidirectional communications interface means respectively connected between said data ports of each of said local  
25 computer control means and said output receiving means and said input producing means, each of said interface means having an associated enabling terminal, each of said interface means for passing data to and from  
30 its associated data port upon activation of its enabling terminal;
  - e) a decoding switch means responsive to a



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coded input for producing a unique enabling output representative of a particular input;

f) means for producing a coded input to said decoding switch means;

5 g) means interconnecting the enabling outputs of said decoding switch means to said enabling terminals of each of said interface means for enabling same to pass data between associated local computer means and said input producing means and said output receiving means.

10 17. A control system for controlling the actuation of a plurality of components of each section of a machine in accordance with a first predetermined control program and first selected timing data, said machine including a plurality of said sections each  
15 independently operable in phased relationship within the cycle of operation of said machine, said system for enabling the simultaneous and independent operation of said plurality of sections, said system  
20 comprising:

a plurality of local computer means, each respectively associated with one of said sections, each of said local computer means having first non-volatile storage means contain-  
25 ing said first predetermined control program and for containing said first selected timing data therein for controlling the operation of its respective section independently of any other one of said sections;

30 a plurality of interface means, each interposed respectively between one of said local computer means and its associated

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section for actuating the components of said section in accordance with said first predetermined control program and said first selected timing data;

5 and said system further being for controlling the actuation of a plurality of components associated with machine functions common to all of said sections and further comprising:

10 a machine computer means associated with said machine, said machine computer means having second non-volatile storage means containing a second predetermined control program and for containing second selected timing data therein for controlling the operation of at least one of  
15 said machine functions independently of any of said sections;

at least one machine interface means interposed between said machine computer means and a corresponding one of said machine function  
20 components for actuating said machine function components in accordance with said second predetermined control program and said second selected timing data;

terminal means for the display of  
25 predetermined portions of said first and second predetermined control programs, for the display and entry of said first and second selected timing data and for the display and entry of other timing data to replace chosen portions of  
30 said first and second selected timing data;

bidirectional communications means for selectively connecting said terminal means to a

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selected one of said local computer means or machine computer means.

18. A control system in accordance with Claim 14 wherein the hardware component of said machine  
5 computer means is identical to the hardware component of at least one of said local computer means.

19. A control system in accordance with Claim 17 wherein said second non-volatile storage means for  
10 storing said second predetermined control program is an unalterable storage means.

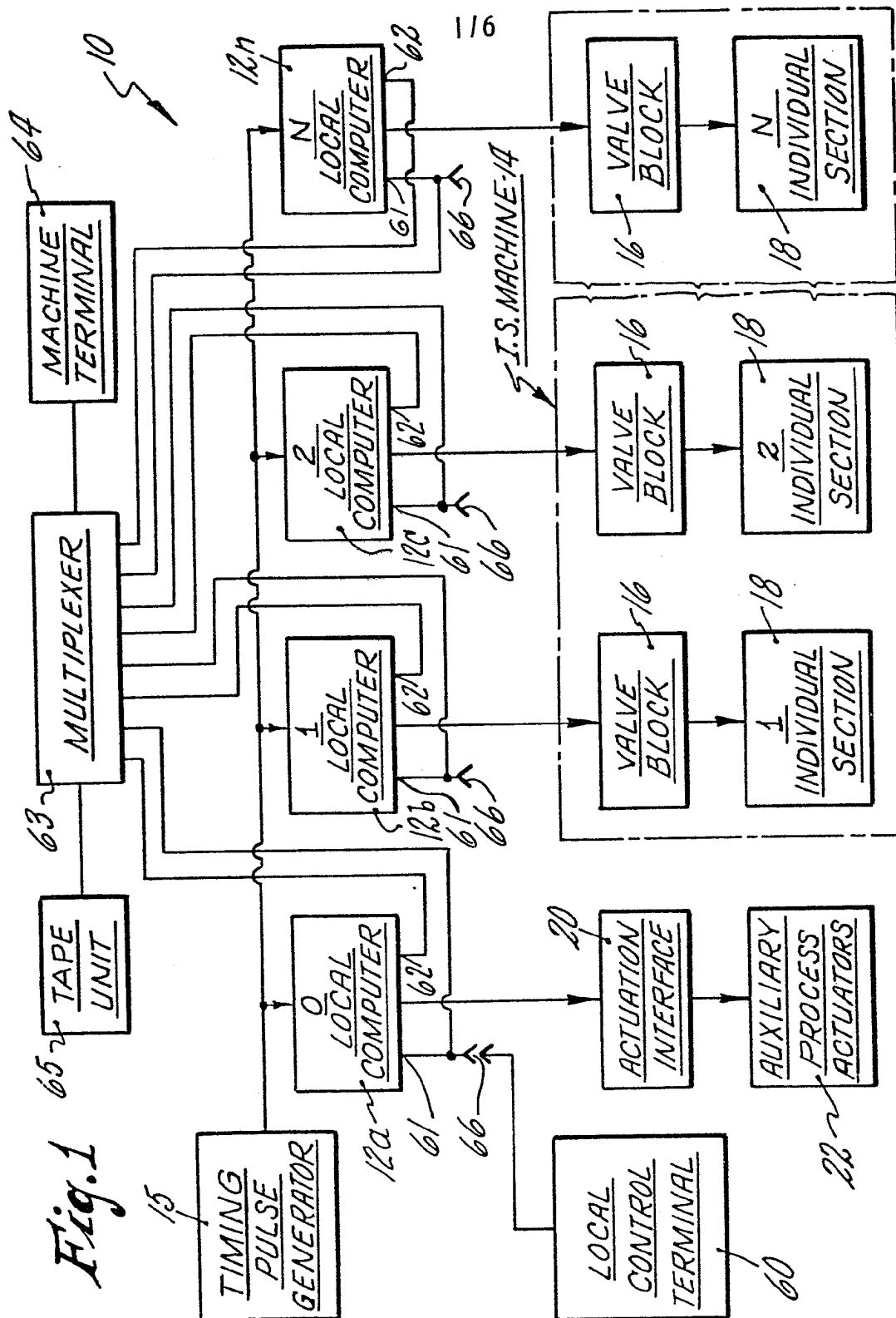
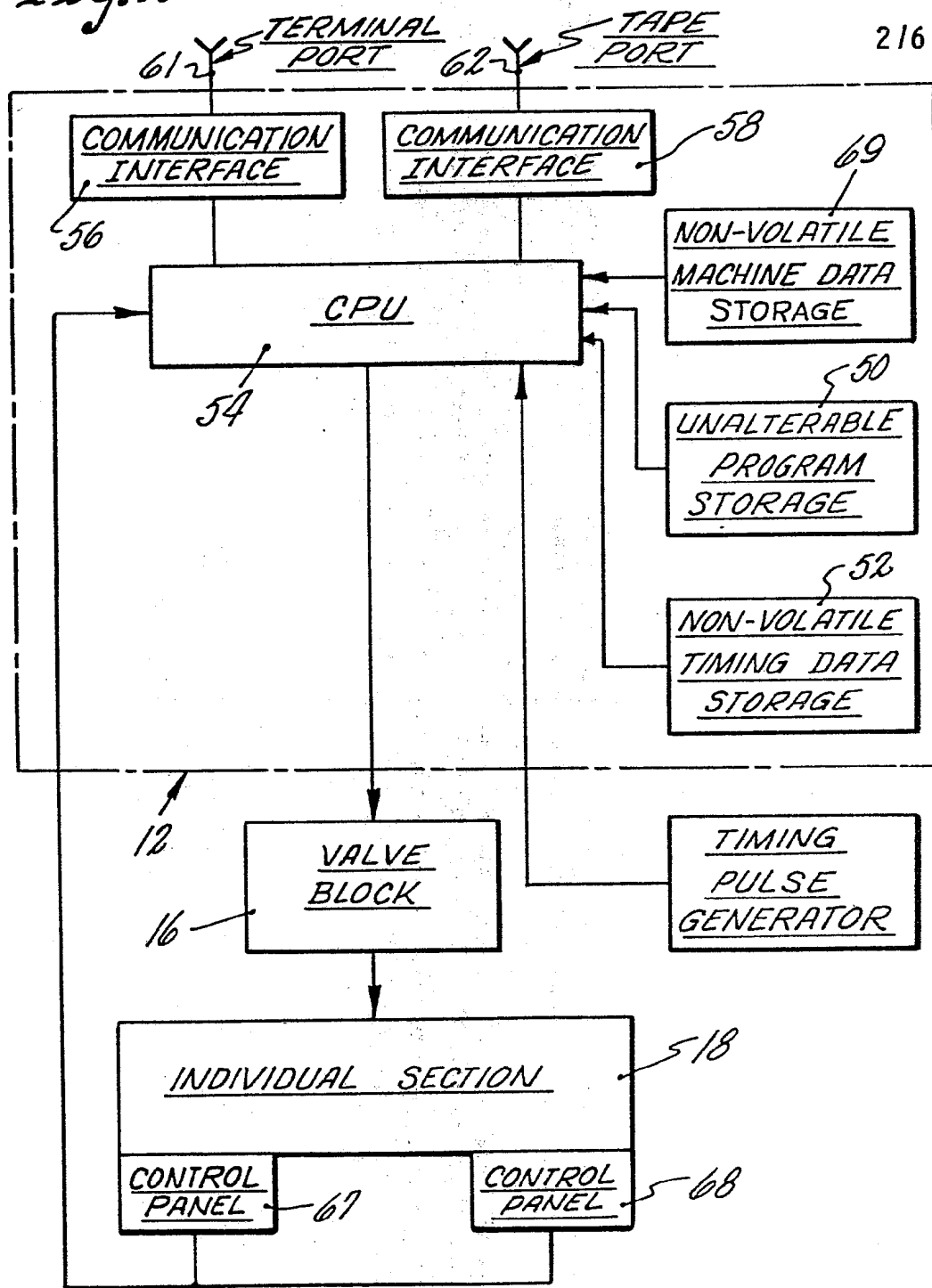
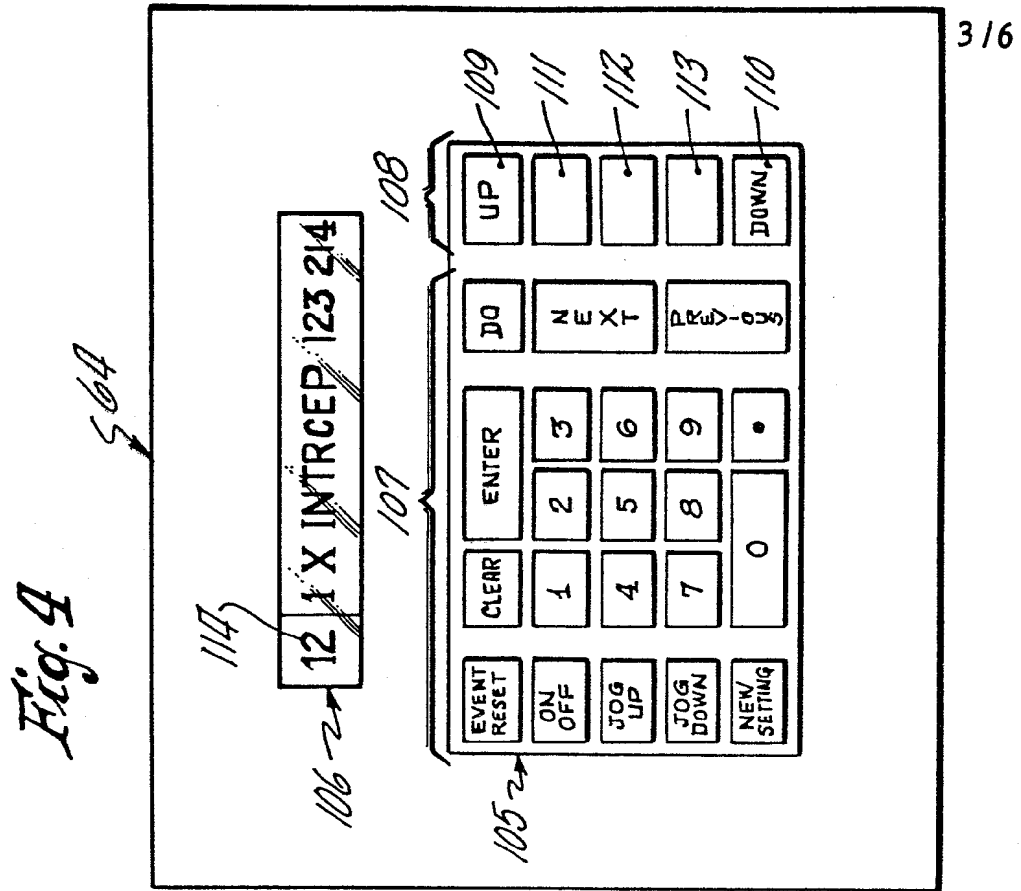
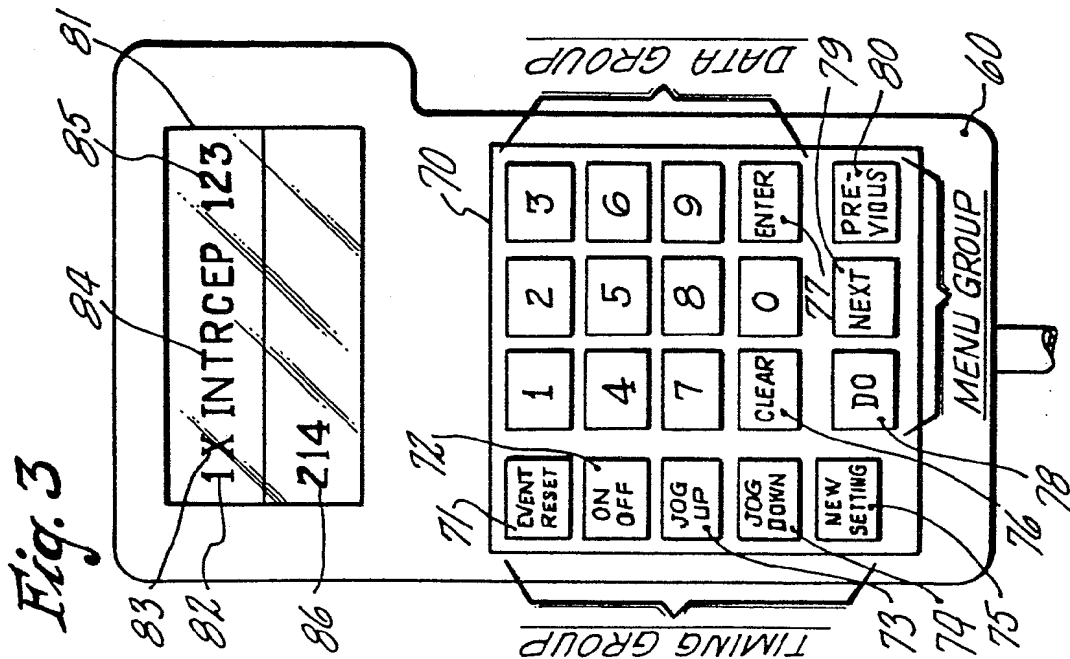
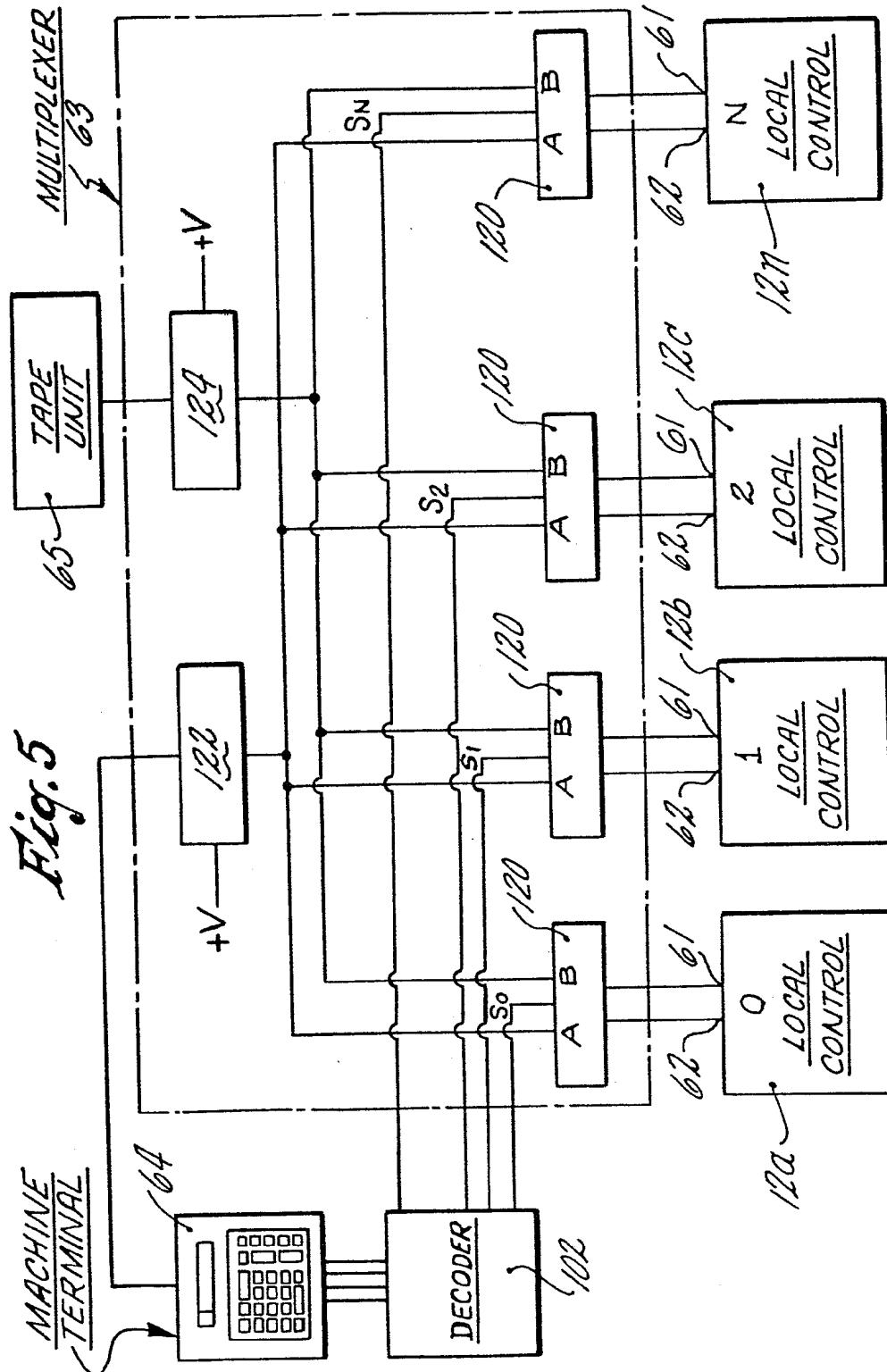


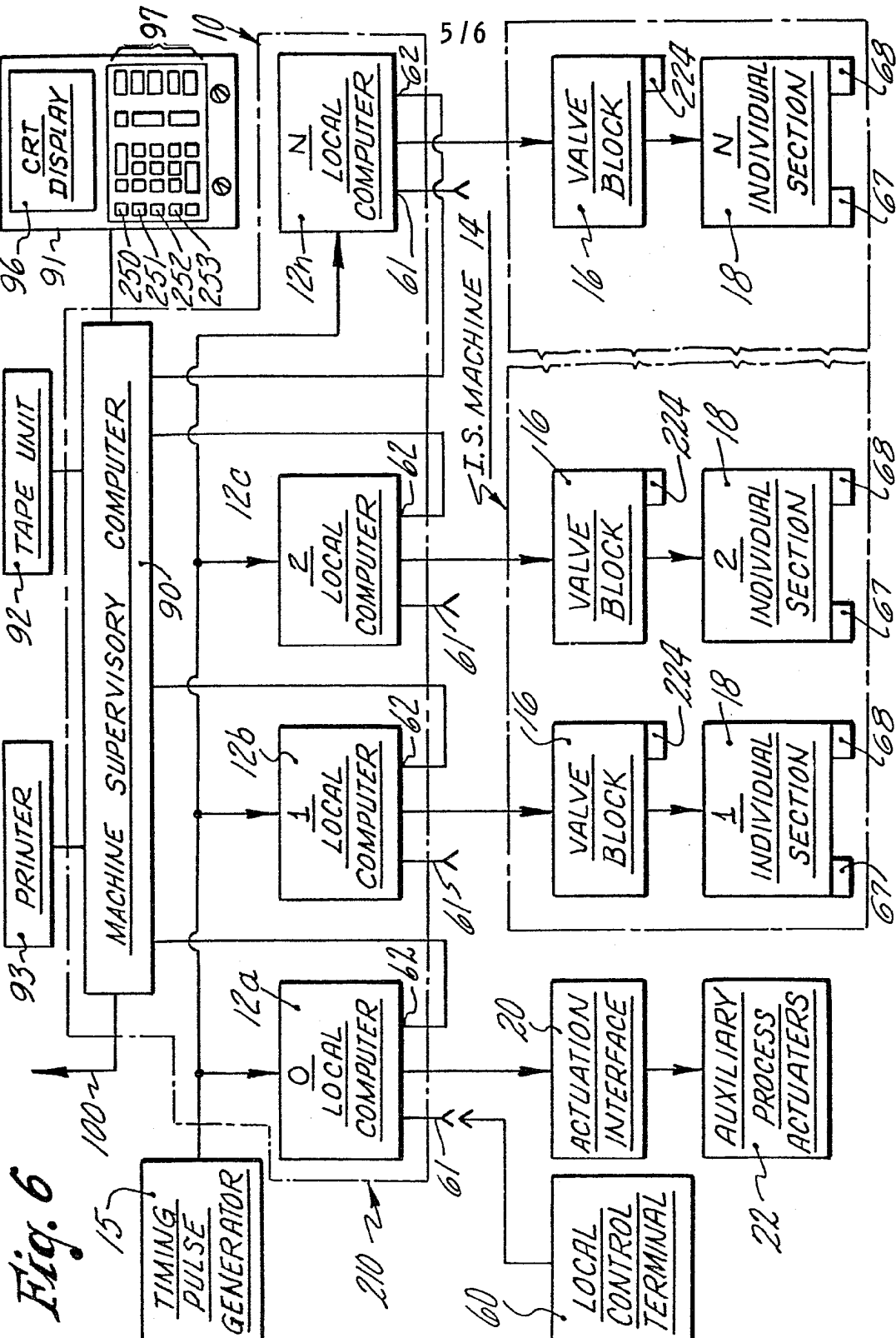
Fig. 1

Fig. 2





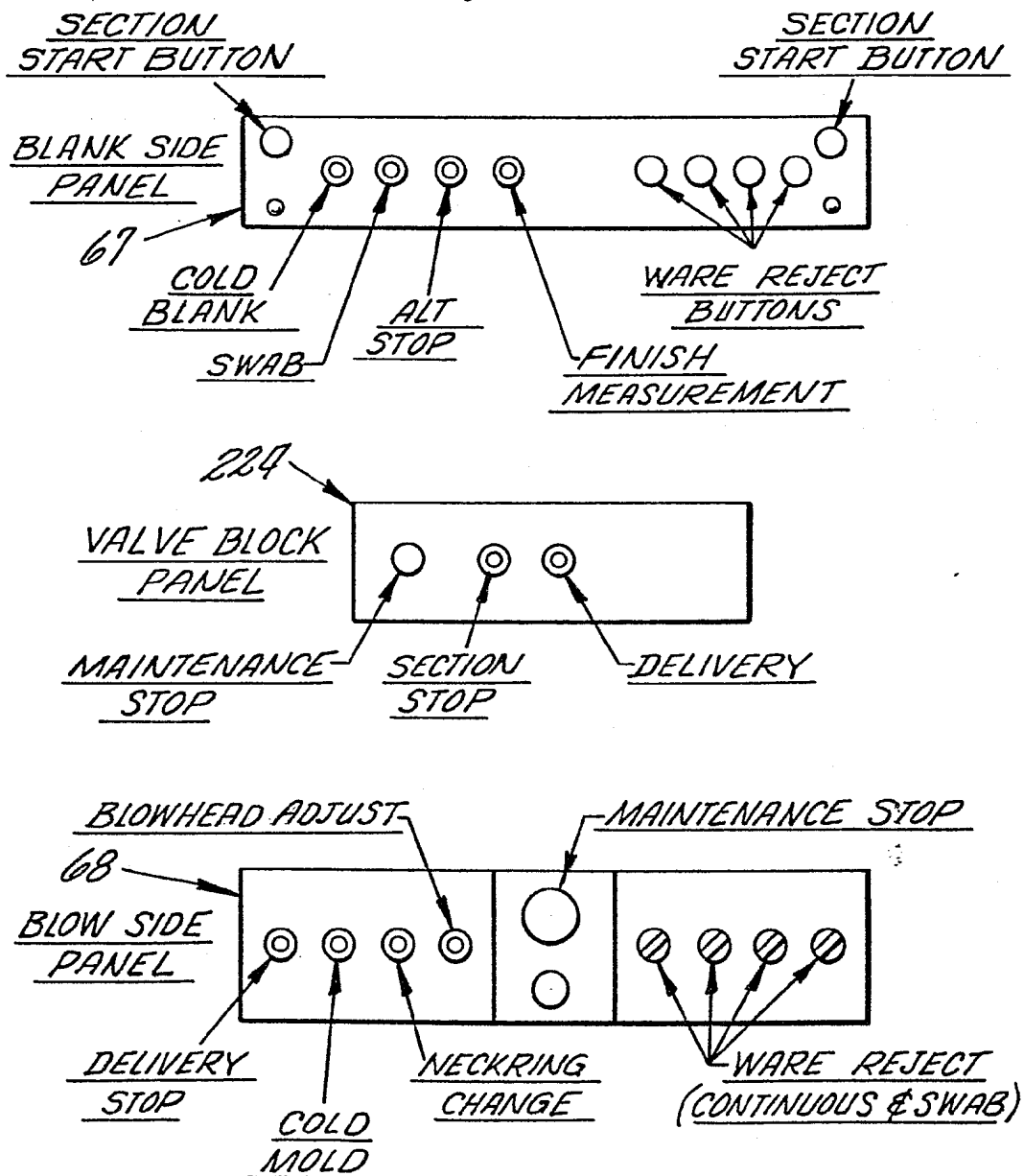






*Fig. 7*

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. <sup>3</sup> )
X	GB-A-2 095 428 (OWENS-ILLINOIS INC.) * Claims 1, 8-12, 15-22; figures 2, 3 *	1	C 03 B 9/40 G 05 B 19/04
A	--- US-A-4 338 116 (N.T. HUFF et al.) * Claims 1, 8; figure 1 *	1	
D,A	--- US-A-4 152 134 (W.T. DOWLING et al.) * Claims 1, 4, 14, 15; figures 1, 3, 4 *	1	
A	--- US-A-4 141 711 (E.R. ZABOR) * Claim 1; figure 1 *	1	
A	--- US-A-4 362 544 (J.D. MALLORY) * Claim 2; figure 7 *		TECHNICAL FIELDS SEARCHED (Int. Cl. <sup>3</sup> )
D,A	--- GB-A-2 022 870 (HAWKER SIDDLEY DYNAMICS ENGINEERING LTD.) * Claims 1, 2, 10 *	1	C 03 B 9/40 G 05 B 19/04
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 30-04-1984	Examiner STROUD J.G.
<b>CATEGORY OF CITED DOCUMENTS</b>			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	